Date: Fri, 28 Jun 2002 17:04:35 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>
cc: <nann@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>,
<waltf@iucf.indinaa.edu>, <penttila@lanl.gov>
Subject: Titanium (fwd)
Status:

Dear Jim: Here is our response to your questions about the use of titanium as the material for the LH2 vessel.

Please let us know if this is enough information for the committee to make a decision.

Yesterday we got vendor quotations for the titanium LH2 vessel. We would like to select the vendor as soon as possible. Please let us know ASAP when the safety committee can make a decision on this issue, which is the most time-sensitive issue on the change-control list.

On the change control request associated with the vacuum chamber design: this will be sent to you early next week in parallel with submission to vendors.

Mike Snow
Indiana University/IUCF
2401 Milo B. Sampson Lane
Bloomington, IN 47408
(812)-855-7914 IUCF
(812)-855-8516 Swain
(812)-855-6645 IUCF FAX

---------- Forwarded message ----------
Date: Fri, 28 Jun 2002 16:52:40 -0500
From: Hermann Nann <nann@iucf.indiana.edu>
To: snow@iucf.indiana.edu
Subject: Titanium

Mike,
attached is my write up about why we can use titanium for the LH2 target vessel.
Hermann

Content-Type: APPLICATION/MSWORD; NAME="Pro_Titanium.doc"; X-MAC-TYPE=42494E41; X-MAC-CREATOR=4D535744
Content-ID: <Pine.HPX.4.33.0206281700022.19131@clio.iucf.indiana.edu>
Content-Description:
Content-Disposition: ATTACHMENT; FILENAME="Pro_Titanium.doc"

Attachment converted: mendius:Pro_Titanium.doc (WDBN/MSWD) (000E41B3)

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Mon, 1 Jul 2002 07:17:02 -0600
To: Jeff Schinkel <jeffs@lanl.gov>, penttila@lanl.gov, bowman@lanl.gov
From: James Knudson <jknudson@lanl.gov>
Subject: Fwd: Titanium (fwd)
Status:

Here is information from IUCF regarding titanium for their vacuum vessel.

Jim K.
Date: Fri, 28 Jun 2002 17:04:35 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>
cc: <nann@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>,
<waltf@iucf.indinaa.edu>, <penttila@lanl.gov>
Subject: Titanium (fwd)

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Please let us know if this is enough information for the committee to make a decision.

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(812)-855-8516 Swain

(812)-855-6645 IUCF FAX

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Mon, 1 Jul 2002 18:02:52 -0600
To: penttila@lanl.gov, bowman@lanl.gov, Jeff Schinkel <jeffs@lanl.gov>
From: James Knudson <jknudson@lanl.gov>
Subject: Mess
Status:

Here is the text of what I sent to the committee, without the attachment.

Gentlemen-

The Change Board for the IUCF H2 target has received a request from Mike Snow to consider making the pressure vessel from titanium as opposed to the magnesium/aluminum combination that was considered at our formal meeting in December. I am including the justification that we received from Mike. Briefly, the IUCF people have found that NASA routinely uses titanium for LH2 tanks used in spacecraft, and that oxide layers actually slow the process.

The Change Board is favorably inclined toward accepting this change; the material is acceptable from the physics standpoint, and eliminates the weld issue that we had with the previous design. However, this new design is dependent on quality assurance issues important to preventing embrittlement - surface polishing, annealing, and ensuring the proper formation of the oxide layer.

We are therefore asking for your advice regarding this design and in particular regarding the finishing required for titanium, and if you are aware of any shops that could do this work properly.

On a separate issue, Trevor Lucas has retired from ORNL and decamped for Great Britain. We would like to replace him with another expert outside of LANL. Any suggestions?

As Snow is anxious to get his bid package out for the vacuum vessel, we would appreciate hearing from you by 12 July if possible.

Thanks
Jim Knudson

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Fri, 5 Jul 2002 15:28:02 -0600
To: penttila@lanl.gov
From: James Knudson <jknudson@lanl.gov>

Subject: Fwd: Re: Change request from Snow
Status:

From: "schneide4" <schneide4@cox.net>
To: "James Knudson" <jknudson@lanl.gov>
Subject: Re: Change request from Snow
Date: Tue, 2 Jul 2002 13:24:56 -0400
X-Priority: 3

Dear Jim,

I have no objection to using titanium as this is what we use on our current pressure vessels at Jlab for the SRF cavities. We of course have liquid helium (2 - 4 K) in the vessels rather than liquid hydrogen (25 K) and we chose titanium to match the thermal contraction of the niobium cavities. I have never used titanium for hydrogen but I see no reason why one could not use titanium grade #2 for this purpose. We have had Joseph Oats in Camden New Jersey and PHPK in Columbus Ohio build our pressure vessels per the ASME pressure vessel Code Section VIII Division 1. I have attached a paper of our SNS vessel built by Joseph Oats. At Jlab we weld titanium routinely and where we have to go to stainless we use explosively bonded joints.

Regards Bill Schneider

----- Original Message -----
From: "James Knudson" <jknudson@lanl.gov>
To: <LH2 review committee:>
Sent: Monday, July 01, 2002 8:02 PM
Subject: Change request from Snow

Gentlemen-

The Change Board for the IUCF H2 target has received a request from Mike Snow to consider making the pressure vessel from titanium as opposed to the magnesium/aluminum combination that was considered at our formal meeting in December. I am including the justification that we received from Mike. Briefly, the IUCF people have found that NASA routinely uses titanium for LH2 tanks used in spacecraft, and that oxide layers actually slow the process.

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We are therefore asking for your advice regarding this design and in particular regarding the finishing required for titanium, and if you are aware of any shops that could do this work properly.

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As Snow is anxious to get his bid package out for the vacuum vessel, we would appreciate hearing from you by 12 July if possible.

Thanks
Jim Knudson

Attachment converted: mendius:PAC_SNS_Cavity_Supportrev.doc (WDBN/MSWD) (000E5B54)

Date: Mon, 22 Jul 2002 12:20:46 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>
cc: <penttila@lanl.gov>
Subject: safety committee
Status:

Jim: Did you get feedback from all the committee members on the titanium vessel question?

Mike Snow
Indiana University/IUCF
2401 Milo B. Sampson Lane
Bloomington, IN 47408
(812)-855-7914 IUCF
(812)-855-8516 Swain
(812)-855-6645 IUCF FAX

Date: Thu, 25 Jul 2002 16:33:14 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: James Knudson <jknudson@lanl.gov>
cc: <penttila@lanl.gov>
Subject: Re: safety committee
Status:

Jim: The next issue is the question of the double-walled design (original) versus the

design with He gas channels around all welds and seals (new).

Have you distributed the drawings to all the relevant committee members? Any questions yet that we can address?

The deadline for our vendor quotes on the vacuum vessel is tomorrow. They are all quoting on both designs. After that we will take a while to select a vendor. Then shortly after that selection, we will need to choose which design to go with.

In the comments on the two designs during the question and answer period on the quotations, some vendors have made suggestions which can further strengthen the vessel by making deeper welds etc. As expected, all say that the newer design is easier from a fabrication point of view.

Next topic is the official approval of drawings. Are you set on your end? Soon we will be sending you signed drawings that our current vendors for the windows and LH2 target vessel have agreed to for formal approval so they can start work...

Mike Snow
Indiana University/IUCF
2401 Milo B. Sampson Lane
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(812)-855-7914 IUCF
(812)-855-8516 Swain
(812)-855-6645 IUCF FAX

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Thu, 25 Jul 2002 16:18:32 -0600
To: William Michael Snow <snow@iucf.indiana.edu>
From: James Knudson <jknudson@lanl.gov>
Subject: Re: safety committee
Cc: penttila@lanl.gov
Status:

Mike-

I'm planning on sending the drawings on to the committee this afternoon, mail server permitting. Zipping the pdfs saves 0%, so big files are going out. I will have the committee send technical questions to you.

The LANL approval method has been worked out. An individual with the Project Management Division has been identified, although I am not yet aware of any more

details of the process or even if there are any. I would have you send your drawings on to me when you are ready to send them and we will make things happen at this end.

Jim K.

Date: Thu, 25 Jul 2002 17:23:41 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: James Knudson <jknudson@lanl.gov>
cc: <waltf@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>, <penttila@lanl.gov>
Subject: Re: safety committee
Status:

Dear Jim: Thanks for the update. For the technical questions
it would be good to send them to Bill Lozowski (lozowski@iucf.indiana.edu)
and Walt Fox (waltf@iucf.indiana.edu) as I will be traveling sporadically.

Mike Snow
Indiana University/IUCF
2401 Milo B. Sampson Lane
Bloomington, IN 47408
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(812)-855-8516 Swain
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On Thu, 25 Jul 2002, James Knudson wrote:

> Mike-
>
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> afternoon, mail server permitting. Zipping the pdfs saves 0%, so big
> files are going out. I will have the committee send technical
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> Project Management Division has been identified, although I am not
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> any. I would have you send your drawings on to me when you are ready
> to send them and we will make things happen at this end.
>
> Jim K.
>

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Thu, 25 Jul 2002 16:25:52 -0600
To: LH2 review committee:;
From: James Knudson <jknudson@lanl.gov>

Subject: Vessel design updates
Cc: penttila@lanl.gov
Status:

Gentlemen-

Mike Snow has sent me electronic (pdf) versions of the latest designs for the vacuum vessel. Specifically, IUCF is modifying the method by which the joints and welds are surrounded by helium and this set of changes needs to be approved by the committee. Please look these over and return comments to me. Technical questions should go directly to Mike at snow@iucf.indiana.edu.

I will send the 2 files in separate emailings as they are big and might be unfriendly to your mail servers. If so (ie., you don't get them or get a nastygram from your mail administrator), please let me know and we will work out an alternative plan (like ftp).

The files are each in zip format and contain about 20 pdf files each when unzipped.

Jim Knudson

Date: Thu, 1 Aug 2002 15:36:48 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: James Knudson <jknudson@lanl.gov>
cc: <waltf@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>, <penttila@lanl.gov>
Subject: Re: safety committee
Status:

Jim:

We got back the quotes for the 2 LH2 vacuum designs a couple of days ago.

We had an interesting suggestion from one of the vendors with respect to the "box" design that you might want to relay to the committee members. The suggestion was to machine the entire box part out of a single piece of aluminum. (Believe it or not, sufficiently large pieces of aluminum exist). This would eliminate a number of welds (and therefore helium gas channels) in the corners of the box, thereby increasing safety /reliability/strength of the vessel.

Are you getting reactions/questions from the committee that we can start to address?

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X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Thu, 1 Aug 2002 15:02:14 -0600
To: LH2 review committee:;
From: James Knudson <jknudson@lanl.gov>
Subject: Fwd: Re: safety committee
Cc: penttila@lanl.gov
Status:

Gentlemen-

Here is a recent communication from Mike Snow suggesting the use of a monolithic block of aluminum to avoid some welds, joints and associated helium blanketing. Comments?

Thanks-
Jim Knudson
Date: Thu, 1 Aug 2002 15:36:48 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: James Knudson <jknudson@lanl.gov>
cc: <waltf@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>, <penttila@lanl.gov>
Subject: Re: safety committee

Jim:

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Bloomington, IN 47408
(812)-855-7914 IUCF

(812)-855-8516 Swain
(812)-855-6645 IUCF FAX

Date: Wed, 7 Aug 2002 08:10:57 -0400 (EDT)
From: Mikell Seely <mseely@jlab.org>
To: Bill Lozowski <lozowski@iucf.indiana.edu>
cc: William Michael Snow <snow@iucf.indiana.edu>,
  James Knudson <jknudson@lanl.gov>, Seppo Penttila <penttila@lanl.gov>,
  Walt Fox <fox@iucf.indiana.edu>
Subject: Re: Fwd: Re: Fwd: Re: safety committee (fwd)
Status:

On Tue, 6 Aug 2002, Bill Lozowski wrote:

> Dear Mike Seely,
>
> The interior and exterior vacuum-tight welds are necessary to seal the
> helium channels everywhere there is a weld. The helium, at
> above-atmospheric pressure, between welds, the inner and outer windows,
> and double o-ring sealed flanges ensures that helium not air will enter
> the insulating vacuum everywhere a leak could develop. This scheme was
> implemented to satisfy a recommendation from the Safety Committee that
> we attend to this issue. Walt Fox said the exterior welds on the box
> should not be necessary for the structural loads.

I joined the safety committee relatively recently. I was not aware of
a recommendation to include this helium channel. I thought that the
helium channel was for the purpose of leak checking the double weld and
that welding on one side only would eliminate the helium channel.

>
> Two companies, Ability Engineering Technology and McPherson, Inc. have
> emerged as strong candidates to build/test the vacuum chamber. Both
> asked good questions about the design, have extensive experience with
> building high-vacuum vessels, returned bids within our budget, and both
> have in-house Al-certified welders and helium MS leak testers. We've
> asked them to quote the price to machine the box from a solid piece, but
> neither has yet responded. Naturally, we expect the price to be more
> but, just maybe, it'll still be affordable. In any case, the consensus
> at IUCF is that the box design is superior and we hope the Committee
> agrees.
>
I have never delt with McPherson, but I have delt with Ability products.

I would recommend that you stay away from Ability Engineering.

Mike Seely

> Best regards,
> Bill Lozowski
>
>
>
>
>
> William Michael Snow wrote:
> >
> > Dear Bill and Walt: Jim Knudson got this reaction from Mike Seeley
> > at Jlab who is on the safety committee. He asked us to
> > email an "informal" response to Mike's questions/comments to Mike
> > and copy Jim and Seppo. Can you get together and come up with a response?
> > It would help to know the cost estimate for the solid Al option if we have
> > this info now...
> >
> > Mike Snow
> > Indiana University/IUCF
> > 2401 Milo B. Sampson Lane
> > Bloomington, IN 47408
> > (812)-855-7914 IUCF
> > (812)-855-8516 Swain
> > (812)-855-6645 IUCF FAX
> >
> > ---------- Forwarded message ----------
> > Date: Tue, 6 Aug 2002 09:54:43 -0600
> > From: James Knudson <jknudson@lanl.gov>
> > To: Mike Snow <snow@iucf.indiana.edu>, penttila@lanl.gov
> > Subject: Fwd: Re: Fwd: Re: safety committee
> >
> > Comments from Mike Seely. JK
> > >Date: Fri, 2 Aug 2002 14:12:13 -0400 (EDT)
> > >From: Mikell Seely <mseely@jlab.org>
> > >To: James Knudson <jknudson@lanl.gov>
> > >Subject: Re: Fwd: Re: safety committee
> > >
> > >I have no safety objections to the proposed design.
> > >As for cost and ease of manufacture: Is it necessary
> > >to have vacum tight welds on both the interior and the
> > >exterior ? We generally weld aluminum OVCs on the
> > >exterior. This is contrary to the standard practice for

> > >good vacuum (weld on the inside) but we find that it
> > >is quite adequate for an isolation vacuum. Welding on
> > >the exterior is much easier for the welder and makes
> > >getting a vacuum tight weld at the corners more likely.
> > >If welds on both sides are needed for strength then I
> > >would suggest making one of them (interior) intermittent.
> > >
> > >I have seen some fairly large aircraft parts machined from
> > >solid blocks of aluminum. However, I would think that this
> > >would be a very expensive option. Getting vacuum tight welds
> > >on aluminum is not particularly easy. I would expect that
> > >even an experienced welder would need a couple of tries to
> > >get something like this leak tight. As long as the vendor
> > >has a helium leak detector and some experience in fabricating
> > >aluminum vacuum chambers, I would not see this as a problem.
> > >The vendor should also recognize that final cuts on the
> > >sealing surfaces should be taken after the bulk of the
> > >welding is done.
> > >
> > >Mike Seely
>

Date: Fri, 9 Aug 2002 17:13:54 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
To: James Knudson <jknudson@lanl.gov>
cc: <snow@iucf.indiana.edu>, <penttila@lanl.gov>, <nann@iucf.indiana.edu>,
<lozowski@iucf.indiana.edu>, <waltf@iucf.indiana.edu>
Subject: Re: Fwd: Re: Fwd: Re: safety committee
X-Perlmx-Spam: Gauge=, Probability=0%, Report="DEAR_SOMEBODY,
IN_REP_TO"
Status:

Dear Jim: A couple of questions/updates:

(1) first official drawings to be sent to LANL will be the main vacuum windows and
the titanium vessel. Idea is to email them to you with the "approval" blank in the drawing file "signed" by Bill Lozowski. If this does not count as a signature let us know: it seems better than signing actual hardcopy drawings...

(2) in a couple of weeks we will send you a revised gas handling system design based on safety committee feedback from the December meeting and what we know at present about the hydrogen source. We
will submit a version which can work for either the HOGEN generator or the bottle-filling scenario, since that has yet to be decided. This will not

be a "change control" request:
rather this was a remaining issue from the December safety meeting. It will include a detailed conceptual diagram of the gas handling system along with specific proposed hardware devices to be used. IN parallel we will submit our choices for setpoint pressures and justification: Hermann Nann will do this once he returns from vacation in a couple of weeks. If there is anything beyond this that you want to see for evaluating the gas handling system at this stage please remind us. Our intention would be then to proceed with construction of the gas handling system based on the response/remaining feedback of the committee.

(3) On the vacuum vessel change control request: we have responded to Mike Seeley's comments/questions and we are waiting for a response from vendors regarding the possibility of reducing the number of welds by machining the main piece of the "box" design out of one piece of aluminum. We expect to have this information by the end of next week and we would like to be in a position to both award the contract and tell the vendor which version of the vacuum system to make at that time so that we can make our late Sept./early Oct. target date for completion of the main vacuum system.

Question on (3) is, do you think the committee will be in a position to make a ruling by the end of next week? Have there been any other committee questions/comments that we can respond to?

Mike Snow
Indiana University/IUCF
2401 Milo B. Sampson Lane
Bloomington, IN 47408
(812)-855-7914 IUCF
(812)-855-8516 Swain
(812)-855-6645 IUCF FAX

Date: Thu, 15 Aug 2002 15:01:51 -0500 (EST)
Subject: Re: Fwd: Re: Fwd: Re: safety committee
From: "William Michael Snow" <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>
X-UserAgent: Mozilla/4.7C-CCK-MCD {C-UDP; EBM-APPLE} (Macintosh; I; PPC)
X-UserHost: 129.6.121.10 [129.6.121.10]
X-Sender: snow@iucf.indiana.edu
Cc: <snow@iucf.indiana.edu>, <lozowski@iucf.indiana.edu>,
<waltf@iucf.indiana.edu>, <penttila@lanl.gov>
X-Perlmx-Spam: Gauge=, Probability=0%, Report="DEAR_SOMEBODY, IN_REP_TO, SUBJ_HAS_Q_MARK"
Status:

Jim: Thanks for response. The only issue at the moment that we are waiting on is the judgement on the design alternatives for the LH2 vacuum vessel, for which we have sent the drawings...

> Mike-
>
>>Dear Jim: A couple of questions/updates:
>>
>>(1) first official drawings to be sent to LANL will be the main vacuum
>>windows and
>>the titanium vessel. Idea is to email them to you with the "approval"
>>blank in the drawing file "signed" by Bill Lozowski. If this does not
>>count as a signature let us know: it seems better than signing actual
>>hardcopy drawings...
>
> This is fine. The Lab is moving in a similar direction, although we
> do tend to have signed hardcopy on file somewhere. In this case, with
> 2 institutions involved, you would probably be the one to have
> hardcopy. Even better, the only actual paper copies should ideally be
> located with the experiment.
>
>
>>
>>(2) in a couple of weeks we will send you a revised gas handling system
>>design based on safety committee feedback from the December meeting and
>>what we know at present about the hydrogen source. We
>>will submit a version which can work for either the HOGEN generator or
>>the bottle-filling scenario, since that has yet to be decided. This
>>will not be a "change control" request:
>>rather this was a remaining issue from the December safety meeting. It
>>will include a detailed conceptual diagram of the gas handling system
>>along with specific proposed hardware devices to be used. IN parallel
>>we will submit our choices for setpoint pressures and justification:
>>Hermann Nann will do this once he returns from vacation in a couple of
>>weeks. If there is anything beyond this that you want to see for
>>evaluating the gas handling system at this stage please remind us. Our
>>intention would be then to proceed with construction of the gas
>>handling system based on the response/remaining feedback of the
>>committee.
>
>
> I can't think of anything beyond what was in the committee's report.
> We will look for the design.
>
>>
>>(3) On the vacuum vessel change control request: we have responded to

>>Mike Seeley's comments/questions and we are waiting for a response from
>>vendors regarding the possibility of reducing the number of welds by
>>machining the main piece of the "box" design out of one piece of
>>aluminum. We expect to have this information by the end of next week
>>and we would like to be in a position to both award the contract and
>>tell the vendor which version of the vacuum system to make at that time
>>so that we can make our late Sept./early Oct. target date for
>>completion of the
>>main vacuum system.
>>
>>Question on (3) is, do you think the committee will be in a position to
>>make a ruling by the end of next week? Have there been any other
>>committee questions/comments that we can respond to?
>
> I'll work to get your information out to the committee as soon as I
> get it from you. I'm not aware of any other issues that have arisen.
>
> Jim K.
>
>>
>>
>>
>>
>>Mike Snow
>>Indiana University/IUCF
>>2401 Milo B. Sampson Lane
>>Bloomington, IN 47408
>>(812)-855-7914 IUCF
>>(812)-855-8516 Swain
>>(812)-855-6645 IUCF FAX

Date: Fri, 7 Feb 2003 00:13:55 -0500 (EST)
Subject: [Fwd: Model of PLC/SLC Software and Firmware Organization]
From: "W. Mike Snow" <snow@iucf.indiana.edu>
To: <penttila@lanl.gov>, <knudson@lanl.gov>
X-Priority: 3
Importance: Normal
Cc: <snow@iucf.indiana.edu>, <leuschner@iucf.indiana.edu>
Reply-To: snow@iucf.indiana.edu
X-Perlmx-Spam: Gauge=XIII, Probability=13%, Report="DEAR_SOMEBODY"
Status:

Dear Seppo and Jim:

enclosed please find a block diagram which outlines the
communication protocols by which the LH2 taregt PLC system can communicate

to the outside world. Ethernet works, but it requires software on the
other end
to display the info...

As I recall from the safety meeting LANL will need to know the state of
the LH2 target. We are approaching the time when we will need to know the
details of what sort of information LANL will want about the taregt state, what
software will be needed, etc. who is the person that we will need to interface with about
this issue?
Jim, how do the Lujan moderators report their state to the control room?

Mike

Date: Sat, 8 Feb 2003 16:28:20 -0500 (EST)
Subject: change con trol request for LH2 taregt refrigerator
From: "W. Mike Snow" <snow@iucf.indiana.edu>
To: <bowman@lanl.gov>, <penttila@lanl.gov>, <jknudson@lanl.gov>,
  <jeff_schienkel@lanl.gov>
X-Priority: 3
Importance: Normal
Cc: <lozowski@iucf.indiana.edu>, <nann@iucf.indiana.edu>,
  <leuschner@iucf.indiana.edu>
Reply-To: snow@iucf.indiana.edu
X-Perlmx-Spam: Gauge=XIII, Probability=13%, Report="DEAR_SOMEBODY"
Status:

>
> Dear Change Control committee:
>
> IUCF requests a change contol for one of the two refrigerators on the
> LH2 target.
>
> Originally the plan was to use two Gifford-McMahon refrigerators from
> CVI with special-ordered stainless steel parts reduce magnetic field
> gradients from the moving parts. We have one of these refrigerators in
> hand and it has passed all required tests (cooling power, magnetic
> fields, safety committee issues) required for operation in the
> experiment. The remaining (possible) concern is the mechanical
> vibrations that this device might transmit to the target vessel.
> Although most of the vibrations are in the head of the vessel and will
> probably be absorbed to some extent in the coupling to the main vacuum
> chamber, there may be some vibrations at the cold heads.
>
> Recently we have obtained a new so-called "pulse tube"
> cryorefrigerator

> from Cryomech. We believe that this refrigerator is either comparable
> or superior to the
> CVI refrigerator in all areas relevant to the experiment. In
> particular it produces essentially no mechanical vibration. So our
> request is to use this refrigerator in addition to the CVI
> refrigerator as the two refrigerators for the target.
>
> here is a comparison of the two devices:
>
> (1) Reliability
>
> The reliability of the Cryomech from experience (~40,000 hours, ~25,000 hours for
first maintenance) is
> superior to that of the CVI (~25,000 hours, ~10,000 hours for first maintenance).
The basic reason is that
> unlike a Gifford-McMahon refrigerator, the pulse tube refrigerator has
> no cold moving parts.
>
> (2) Cooling Power
>
> We have measured the cooling powers of the cold head of both refrigerators at 17K with the
> following results:
>
> type 17K
>
> Cryomech 7W
> CVI 8.5W
>
> The cooling power of the Cryomech is ~15% smaller than that of the CVI
> in the operating range. This results in approximately the same
> increase in filling time for the liquid.
>
> (3) Magnetism
>
> The CVI refrigerator possesses a 60Hz moving part that is slightly
> magnetic. By special order
> we had this piece made from stainless steel and bounded the
> disturbance in the field caused by this part and the motor to be more
> than an order of magnitude below the value required for the
> experiment.
>
> The Cryomech refrigerator has no moving magnetic parts except for the
> motor, which creates a field that is smaller than that from the CVI.

> Other magnetic componets are the Aeroquip fittings where the He lines
> attach and the electrical fitting for the motor. The field from the
> DC stepper-motor inside the Cryomech housing is smaller than that from
> the CVI motor.
>
> (4) LH2 Safety
>
> Both refrigerators present helium gas between atmosphere and the main
> vacuum throughout the refrigerator body. Therefore both pumps meet the
> safety requirement of helium gas containment of the vacuum chamber.
>
> Both refrigerators operate using helium gas compressors that will be
> located on top of the experimental cave.
>
> (5) Ortho-para conversion
>
> Once or twice over the course of the experiment it may become
> necessary to heat the material in the ortho-para converter cell to
> regenerate its conversion surface. The max temperature that the second
> stage can tolerate is 70C for the Cryomech, 150C for the CVI. The
> material needs to be heated to about 120C. We are designing the
> thermal connections between the ortho-para converter and the
> refrigerators in such a way that, if necessary for this relatively
> rare procedure, the thermal connection can be broken without
> disconnecting the inlet and outlet tubing.
>
> (6) Vibration
>
> The CVI refrigerator produces 60Hz vibrations during operation. The
> Cryomech refrigerator
> has essentially no vibrations that can easily be sensed by human
> touch. It produces some sound at the ~1Hz frequency with which the
> helium gas is looped through the device.
>
> (7) Other implications
>
> Although we require both refrigerators to operate during target
> liquification and ortho-para conversion, it is possible that only one
> of the refrigerators may be required for continuous operation during
> data taking. The use of the pulse tube refrigerator allows for the
> possibility of operating the target with essentially no vibrations.
>
> Mike Snow
> Bill Lozowski
>
> IUCF

>
> --
> W. Mike Snow
> Associate Professor of Physics
> Indiana University/IUCF
> 2401 Milo B. Sampson Ln.
> Bloomington, IN 47408
> IUCF phone: (812) 855-7914
> IUCF FAX: (812)-855-6645
- cell phone:
- (812)-322-2277

Date: Tue, 4 Mar 2003 17:48:30 -0500 (EST)
Subject: safety committee request regarding radiography of fillet welds on the LH2 vacuum chamber
From: "W. Mike Snow" <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>, <penttila@lanl.gov>
X-Priority: 3
Importance: Normal
Cc: <lozowski@iucf.indiana.edu>, <nann@iucf.indiana.edu>,
<waltf@iucf.indiana.edu>, <leuschner@iucf.indiana.edu>
Reply-To: snow@iucf.indiana.edu
X-Perlmx-Spam: Gauge=XIII, Probability=13%, Report="DEAR_SOMEBODY"
Status:

Dear Safety Committee members:

We want to make a change control request on the requirement of radiography of the welds on the main vacuum system for the NPDG liquid hydrogen target. The original recommendation of the safety committee for radiography for these welds was based on the type of welds (full penetration welds) in the design that the safety committee had available at that time of the review. In the meantime, however, the design changes to the main vacuum system involved a change in the type of welds to fillet welds, for which the ASME code states that radiography is not applicable. We therefore request the permission of the safety committee to forego what we understand to be a useless radiographic examination of the fillet welds on the main vacuum chamber.

The original report of the LH2 safety committee requested radiography of welds for the vacuum chamber and target chamber. This recommendation was based on the design of the main vacuum chamber presented at the time, which involved helium-jacketed cylinders. Later the safety committee approved a modified design of the main vacuum chamber in which gas channels around the weld joints were substituted for an all-encompassing jacket and in which the strength of the target was

increased by machining a portion of the chamber out of a single piece of aluminum, thereby reducing the number of welds. In addition, the wall thickness of the aluminum was increased in the weld areas to increase strength.

In the approved modified design, the cylindrical part of the main vacuum chamber is joined to the thick-walled box by double full-fillet welds. Such welds are allowed by the ASME code and no radiography is required when the joint design complies with Table UW-12 (c) in the Code. Table UW-12 also states that neither full nor spot radiographic examination is applicable to fillet weld joints. Fillet welds are not full penetration welds, and the purpose of radiography is to verify full penetration welds. Our strength calculations show that the wall thickness of 0.125 inch for the cylindrical part of the vacuum vessel and a weld efficiency of 0.55 (from table UW-12) gives a calculated maximum allowable pressure of 94 psia. The vacuum chamber has successfully been pressure tested to 95 psia.

In parallel with this result for the pressure test and redesign of the vacuum vessel, there have also been changes to the gas handling system design which lower the working pressure of the vessel. With the increase in the inner diameter of the pressure relief line for the vacuum vessel from 2.5 to 3.75 inch, we estimate that the outlet pressure for a worst-case accident scenario has been lowered to less than 25 psia (calculations based on the Williamson Jlab report referred to in the LH2 Engineering document). 25 psia is now our maximum operating pressure. The set points for two parallel rupture disks in the pressure relief line from the vacuum vessel are now 15 psid and 70 psid. The vacuum vessel was pressure tested at 80 psid, which is 1.15 times 70 psid. Traditionally, the ASME code requires a pressure test of 1.1 times the MAWP of a vessel

Radiography only has meaning for full penetration welds. The welds in the new main vacuum chamber design are fillet welds. Fillet welds are not radiographed because the primary reason for radiography is to verify complete penetration of the weld. A radiograph of a fillet weld will simply show a line of incomplete penetration. This observation is simply not relevant for evaluating the safety of a fillet weld.

We therefore assert that radiography is not required for the main vacuum chamber of the LH2 target as designed and ask for the safety committee to allow us to forego what we and the Code assert will be a pointless radiograph of the fillet welds on the LH2 vacuum vessel. Of course radiography is being performed on the LH2 target vessel itself as required.

--
W. Mike Snow
Associate Professor of Physics
Indiana University/IUCF
2401 Milo B. Sampson Ln.
Bloomington, IN 47408
IUCF phone: (812) 855-7914
IUCF FAX: (812)-855-6645
cell phone: (812)-322-2277

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Mon, 10 Mar 2003 16:55:50 -0700
To: penttila@lanl.gov, bowman@lanl.gov, Jeff Schinkel <jeffs@lanl.gov>
From: James Knudson <jknudson@lanl.gov>
Subject: Latest request from Snow
Status:

We need to meet to discuss Mike Snow's latest request to the change board. I hope that you have had a chance to digest his email.

I have a LANSCE ops all hands meeting Tues at 3:30, otherwise I'm free all week (Friday is my day off).

Let me start by proposing Wednesday 10 am. We could meet in my office or anywhere convenient.

Thanks
Jim Knudson

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Tue, 11 Mar 2003 08:06:12 -0700
To: penttila@lanl.gov, bowman@lanl.gov, Jeff Schinkel <jeffs@lanl.gov>
From: James Knudson <jknudson@lanl.gov>
Subject: Fwd: safety committee request regarding radiography of fillet
welds on the LH2 vacuum chamber
Status:

Here is the email from Mike Snow.
Date: Tue, 4 Mar 2003 17:48:30 -0500 (EST)
Subject: safety committee request regarding radiography of fillet welds on the LH2 vacuum chamber
From: "W. Mike Snow" <snow@iucf.indiana.edu>
To: <jknudson@lanl.gov>, <penttila@lanl.gov>
X-Priority: 3

Importance: Normal
Cc: <lozowski@iucf.indiana.edu>, <nann@iucf.indiana.edu>,
  <waltf@iucf.indiana.edu>, <leuschner@iucf.indiana.edu>
Reply-To: snow@iucf.indiana.edu
X-Perlmx-Spam: Gauge=XIII, Probability=13%, Report="DEAR_SOMEBODY"

Dear Safety Committee members:

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In parallel with this result for the pressure test and redesign of the vacuum vessel, there have also been changes to the gas handling system

design which lower the working pressure of the vessel. With the increase in the inner diameter of the pressure relief line for the vacuum vessel from 2.5 to 3.75 inch, we estimate that the outlet pressure for a worst-case accident scenario has been lowered to less than 25 psia (calculations based on the Williamson Jlab report referred to in the LH2 Engineering document). 25 psia is now our maximum operating pressure. The set points for two parallel rupture disks in the pressure relief line from the vacuum vessel are now 15 psid and 70 psid. The vacuum vessel was pressure tested at 80 psid, which is 1.15 times 70 psid. Traditionally, the ASME code requires a pressure test of 1.1 times the MAWP of a vessel

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We therefore assert that radiography is not required for the main vacuum chamber of the LH2 target as designed and ask for the safety committee to allow us to forego what we and the Code assert will be a pointless radiograph of the fillet welds on the LH2 vacuum vessel. Of course radiography is being performed on the LH2 target vessel itself as required.

--
W. Mike Snow
Associate Professor of Physics
Indiana University/IUCF
2401 Milo B. Sampson Ln.
Bloomington, IN 47408
IUCF phone: (812) 855-7914
IUCF FAX: (812)-855-6645
cell phone: (812)-322-2277

Joe,
in next three messages I'll send you copies of tgt safety committee reports and then also the tgt engineering document.
This message includes the 1st review report
seppo

Attachment converted: Macintosh HD:npdgamma_review2112.doc (WDBN/MSWD) (0004334C)
Attachment converted: Macintosh HD:APPENDIXI__Design_strawman.doc (WDBN/MSWD) (0004334D)
Attachment converted: Macintosh HD:LH2_tgt_drawing2a.doc (WDBN/MSWD) (0004334E)
Attachment converted: Macintosh HD:APPENDIX_II__Possible_Fail.doc (WDBN/MSWD) (0004334F)
Attachment converted: Macintosh HD:APPENDIX_III-NPDGamma.doc (WDBN/MSWD) (00043350)

X-Sender: penttila@128.165.51.16
Date: Mon, 31 Mar 2003 20:00:34 +0300
To: klose@lanl.gov
From: seppo penttila <penttila@lanl.gov>
Subject: 2nd npdg LH2 tgt safety review report
Status:

Joe,
attached is the copy of the report of the 2nd LH2 tgt safety review, the response to the findings, ARES's report of their strength analysis of the LH2 vessel, and then the LH2 tgt engineering document.
I would like to meet you again. I need to find out the length of the pipes. For that we need a facility drawing from where can see the heights and other dimensions.
Let me know when could we meet.
Thanks,
seppo

Attachment converted: Macintosh HD:2nd_LH2_Review_report_final.doc (WDBN/MSWD) (00043359)
Attachment converted: Macintosh HD:2nd_LH2_Safety_report_response. (WDBN/MSWD) (0004335A)

X-Sender: knudson.jim@email.atdiv.lanl.gov
Date: Tue, 8 Apr 2003 09:23:00 -0600
To: penttila@lanl.gov, bowman@lanl.gov, Jeff Schinkel <jeffs@lanl.gov>
From: James Knudson <jknudson@lanl.gov>
Subject: Snow request of 3/4
Status:

To the change board-

Mike Snow emailed me on 3/4 reqesting a change to the requirements that the vacuum vessel welds be radiographed. I forwarded his email to everyone on 3/11.

Unless someone objects, I would be comfortable handling this request by email.

After talking with the LANSCE-7 welding expert, I propose the following response to Mike:

"We agree that the need for radiography has gone away given that the welds in the vacuum jacket are now full-fillet welds. Our experts concur with the your summary of the welding requirements as given in your email to me on 3/4/03. They do suggest that one or more radiographs taken at an angle through the weld could be useful in uncovering other problems with the assembly."

Please respond to this proposal by COB 4/9 if possible.

Thanks
Jim Knudson

Date: Sat, 3 May 2003 16:51:45 -0500 (EST)
Subject: safety summary etc.
From: "W. Mike Snow" <snow@iucf.indiana.edu>
To: <penttila@lanl.gov>, <jknudson@lanl.gov>
X-Priority: 3
Importance: Normal
Cc: <snow@iucf.indiana.edu>
Reply-To: snow@iucf.indiana.edu
Status:

Seppo and Jim:

enclosed please find some of your request for safety information on the LH2 taregt

IN cluded are the following:

(1) summary of the tests performed on the main vacuum chamber and the titanium
taregt vessel. The aluminum target vessel is under construction at Ability Engineering.

(2) gas handling system design and legend

the drawings are too large to be emailed. I have the drawings to Seppo are on CDs which include all drawings for the target
in pdf, dxf, and Mechanical Desktop formats. There are 3 copies of the CDs.

Let me know what else we can supply you with. WE are working still on the Target Engineering Document.

Mike

Summary of testing documentation for the NPDG LH2 target

M. Snow, 5-1-03

This is a brief summary of the tests performed by vendors who have fabricated parts of the NPDG LH2 target organized by item and vendor. This is not a substitute for the documentation from the vendors which is being sent separately. All welding for all parts was performed by certified welders.

(1) Main vacuum chamber and windows

Ability Engineering Technology
16140 Vincennes Ave.
South Holland, IL 60473
Michael Morgan, president
(708)-331-0025
fax (708)-331-5090

The main vacuum chamber is an aluminum vessel with internal channels which expose
all weld joints and o-ring seals to helium gas from the outside. In addition there are two sets of double windows at the entrance and exit for the neutron beam. The tests discussed here were performed with magnesium windows.

Materials certification

The 6061-T651 aluminum stock (from which the entire box part of the vessel was machined from a single piece to reduce weld joints) is from A. M. Castle Co, 3400 N. Wolf Rd., Franklin Park, IL 60131, 1-800-367-2586 amd made by Kaiser Aluminum. Test results for the lot: tensile strength 50,000 PSI, yield strength 46300 PSI, elongation 15.9%

The 6061-T651 aluminum for the end plate is from Empire Resources, One Parker Plaza, Ft. Lee, NJ 07024 made by Hulett Aluminum Rolled products Ltd. Test results: tensile strength 46,255 PSI, yield strength 40020 PSI, elongation 14%

The 6061-T651 seamless extruded aluminum tube used for the cylindrical

portion of the vacuum chamber is also from A. M. Castle/Kaiser Aluminum. Test results: tensile strength 40,400 PSI or greater, yield strength 39,300 PSI or greater, elongation 16.5% or smaller.

The AZ31B-H24 magnesium sheet for the neutron beam windows are from Copper and Brass Sales, 6555 E. Davidson, Detroit, MI 48212-1499, (847)-490-9870. Test results: tensile strength 42,400 PSI, yield strength 31,200, elongation 15%.

All pieces meet appropriate AMS/ASME/ASTM specifications.

Pressure tests

The assembled chamber with windows was pressurized to 70 psi successfully. The inner domes
were pressure tested to 80 psi and the outer domes to 117 psi.

Helium Leak tests

leak testing of the assembled chamber, the main weldment, and the magnesium domes were performed with a helium leak detector on the 1-10 E-9 cc/sec scale, no leaks found

Radiography

Note that due to the nature of the welds for this vessel radiography is not required arroding to the ASME code and as approved in a Change Control Request to the LANL safety committee. Nevertheless we went ahead and performed radiography anyway. The vendor was Calumet Testing Services, 1945 N. Griffith Blvd., Griffith, IN 46319, (219)-923-9800, (708)-474-5860. Xray radiographs were performed with xray source internal and external to the vessel in specified geometries referenced to stamped letters on the outside of the vessel. As expected the radiographs show the inclusions which are due to the helium gas channels required by the safety committee.

subsequent history at IUCF

Later work at Indiana uncovered a leak in one of the internal welds. This weld was
redone by a certified welder from Ability Engineering and is now helium leak-tight.

(2) Titanium Target Chamber

Excelco Development Inc.

65 Main Street
P.O. Box 230
Silver Creek, NY 14136
(716)-934-2651
fax(716)-934-9246

This liquid hydrogen vessel is an all-titanium cylindrical welded chamber with one inlet and one outlet port with Conflat-type seals. The shape of this vessel was chosen to reduce potential strees concentrations during various accident scenarios based on the results of finite-element analysis calculations performed by a LANL contractor.

Materials certification

The Grade-2 titanium bar and billet stock is from TICO Titanium, 52900 Grand River Avenue, New Hudson, MI 48165 (248)-446-0400, 1-800-521-4392, fac (248)- 446-1995. Test results for the lot: tensile strength 67,400 PSI or greater, yield strength 52300 PSI or greater, elongation ~28%
Typical annealing treatment: 1200F, 1 hour air cool

Helium leak test

Leak test of the chamber was performed at Excelco using a helium leak detector with no leaks visible.

Pressure test

Pressure test of the chamber was conducted successfully at 90 PSI.

Fluorescent liquid inspection

A fluorescent liquid penetrant test was performed by Excelco to look for gross welding faults/crakcs. None were found.

Radiography:

The titanium vessel was radiographed by Excelco. No faults were found.

Heat Treatment

Heat treatment on the target vessel after fabrication was performed by Accu-Temp Heat Treating, INC, 2400 Racine St. , Racine, WI 53403, (262)-634-1905, fax (262)-634-9102.
The vessel was heated in an Argon atmosphere for 1 hour at 1292F and oxidized for 5 minutes at 1400F, then air cooled. This annealing procedure

appears in table 3 of "TIMETAL 50A CP Ti" literature from TIMET corp. The oxidation procedure (5 minutes in air) appears in "Corrosion Resistance of Titanium," a technical manual of TIMET at http://www.timet.com/productsframe.html. Stacey Nyakana, a research person at TIMET (708-566-4403) was consulted in the choice of this prodecure. The object of this treatment was to ensure the development of an oxide layer on the inside surface of the chamber to suppress the possibility of hydrogen entering into the titanium.

Post-treatment tests

Grade-2 Ti tensile-test samples were loaded to failure after they received the annealing and oxidation procedure designed to ensure the existence of a thick oxide layer on the inner Ti surface. The test results, both from the dry run and the run with the Ti vessel, confirmed that the oxide layer formed was tough and adherent and that the mechanical properties of the Ti were not altered from those of annealed grade-2 Ti.

subsequent history at IUCF

Vessel was helium leak tested at IUCF and thermally shocked via repeated immersion in liquid nitrogen without detectable leak on the 1E-9 cc/sec scale.

As a double-check on the annealing-oxidation procedure, the annealing-oxidation procedure was performed at IUCF on seven Ti foil samples that ranged from 0.2 mil to 12.8 mil in thickness. The samples 1.5 mil and thicker remained ductile and had an adherent oxide layer. The oxide layers formed were 200-330 microgram/cm2.

--
W. Mike Snow
Associate Professor of Physics
Indiana University/IUCF
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Bloomington, IN 47408
IUCF phone: (812) 855-7914
IUCF FAX: (812)-855-6645
cell phone: (812)-322-2277

Date: Wed, 14 May 2003 14:06:10 -0500 (EST)
From: William Michael Snow <snow@iucf.indiana.edu>
X-X-Sender: <snow@Zeus>
To: <jknudson@lanl.gov>, <penttila@lanl.gov>
cc: <lozowski@iucf.indiana.edu>, <nann@iucf.indiana.edu>,
<leuschner@iucf.indiana.edu>, <waltf@iucf.indiana.edu>

Subject: questions for safety committee
Status:

Dear Jim and Seppo:

WE need clarification from the safety committee on the location of the boundary between the inside and the outside of the cave. The area in question is the polyethylene shielding cap above the hole in the roof of the cave. The question is, is the volume inside this poly shielding cap but above the top of the roof of the cave considered to be inside the cave or outside the cave.

WE need to know the answer because, as you know, all seals and weld joints connected to the main vacuum system were required by the safety committee to be surrounded by
helium gas. We have done this on the main vacuum system for the taregt chamber and on the flange that connects the top exit of the taregt to the taregt fill line. We have a cylindrical vacuum pipe which shares a common vacuum with the main chamber and which surrounds the taregt fill/vent line. This vacuum pipe needs to be connected to the main vacuum pumps on the gas handling system and to the taregt fill/vent line which exits this pipe. The flange connections for these gas handling system lines in the current design occur inside the polyethylene shielding cap above the cave ceiling level.

If this is considered to be inside the cave we need to
either design helium/channeled seals as for the main taregt vacuum system or surround the seals with helium gas in some other way. If this is considered to be outside the cave then we can use normal Conflat-type seals.

--
W. Mike Snow
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